

Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)

Impact of climate change on global agricultural potentials

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Abstract

Agriculture is challenged by feeding 9 Billion until 2050, while at the same time it is faced with changing climate conditions.

We analysed climate change impacts on agricultural production potentials, in terms of the area suitable for agricultural production, the number of possible harvests per year and potential yield formation on the global scale.

Our analysis shows at high spatial resolution that changing temperature and precipitation will change the patterns of agriculturally suitable area with winning regions in the high latitudes and losing regions mainly in semi-arid regions. Additionally, growing periods will shift in time and change in length. Consequently, dates for sowing and harvesting will alter together with the possibility for multiple cropping. We simulated potential yields for the globe until the year 2100 under A1B scenario conditions for 18 crops, using the biophysical crop growth model PROMET. Thereby, regarding our definition of potential crop production, we assume optimal crop management practices in terms of optimal nutrient supply, optimal sowing and harvest dates, optimal multiple cropping, no harvest losses due to pests, diseases etc. Crop specific water and temperature stress as well as time series of atmospheric CO₂ concentration are considered in the simulation. We analysed both, existing production potentials and the development of the potentials until 2100 under climate change conditions.

For current conditions, we found that global production potential can be increased by 50% when taking advantage of the maximum number of possible harvests per year. Another 20% increase in global production potential can be achieved through optimizing the spatial allocation of crops within agricultural production systems according to their profitability. The results demonstrate the importance of sustainable intensification of agriculture and adaptation to climate change in order to ensure food security.

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